Molar Mass and Moles

1. Determine the molar mass of the following compounds:

HBr HCl $Mg_3(PO_4)_2$ H_2SO_4

2. Determine the number of moles in each of the following:

632g $Ca(C_2H_3O_2)_2$ 294g H_3PO_4 990g HCl 4700 g NaOH

3. Determine the number of grams in the following moles of each compound:

1.4 mol HBr 0.26 mol Fe 2.74 mol CO_2 37 mol $C_6H_{12}O_6$

Stoichiometry Problems

4. Calculate the mass of NaOH is needed to react with 196g of H_3PO_4 in order to produce water and sodium phosphate according to the following reaction:

$$3\ NaOH + \ H_3PO_4 \longrightarrow \ Na_3PO_4 \ + \ 3\ H_2O$$

5. Calculate the mass of O_2 that is needed to react with 117 g Fe to make iron (III) oxide?

$$4\ Fe + \ 3\ O_2 \longrightarrow \ 2\ Fe_2O_3$$

6. Calcium carbonate, $CaCO_3$, decomposes and produces 2.26g calcium oxide, CaO. If the theoretical yield is 2.68g, what is the percent yield?

$$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$$

7. Calculate the mass of NaOH produced when 254 grams of Na_2CO_3 are reacted according to the following reaction:

$$Na_2CO_3 + Ca(OH)_2 \longrightarrow 2\,NaOH + CaCO_3$$

8. Calculate the mass of Cu needed to produce 2.25 g Ag according to the following reaction:

$$Cu + 2\,AgNO_3 \longrightarrow Cu(NO_3)_2 + 2\,Ag$$

9. Calculate the volume of oxygen gas needed to produce 6.5 Liters of CO_2 according to the following reaction:

$$C_3H_8 + 5\,O_2 \longrightarrow 3\,CO_2 + 4\,H_2O$$

Kinetic Molecular Theory

10. For the following pairs, circle the one in which particles are moving the fastest:

    a. A liquid at 50 °C or A liquid at 100 °C

    b. A solid at 50 °C or A liquid at 50 °C

    c. A solid at 100 °C or A gas at 50 °C

    d. He gas at 30 °C or Kr gas at 30 °C

11. Why is the Kelvin temperature scale more appropriate than the Celsius or Fahrenheit scales when thinking about KMT?

Gas Law Problems

12. What are STP conditions?

13. The initial temperature of a gas is 43^{o}C. Calculate the final temperature if the volume changes from 500mL to 350mL at constant pressure?

14. Calculate the original volume of a gas at –10^{o}C if the final volume of gas is 200 gallons at 25^{o}C and pressure is held constant?

15. Calculate the final pressure on a balloon if its volume changes from 250 L at 770 mm Hg to 1000 L with constant temperature?

16. A rigid vessel of gas at STP is heated to 900^{o}C. Calculate the new pressure.

17. Complete the following table using the combined gas law:

Parameter	Initial	Final
Temperature	23°C	58°C
Volume	360mL	150mL
Pressure	230 torr	**?**
Temperature	Standard	105°C
Volume	5L	**?**
Pressure	Standard	2 atm
Temperature	30°C	Standard
Volume	300mL	**?**
Pressure	795 mm Hg	Standard

Solutions

18. Underline the solvent in each of the following solutions

    a. A solution containing 10.0 g of glucose ($C_6H_{12}O_6$) and 500.0 g of water

    b. A solution containing 60.0 mL of ethyl alcohol and 30.0 mL of methyl alcohol

19. Why does water not dissolve motor oil?

20. In which solution is the solubility of a gas higher – cold water or hot water?

21. What three things can you do to get sugar to dissolve faster in water?

22. When a solute is added to water, what happens to the freezing point? To the boiling point?

23. Which will freeze at a lower temperature – a 1.5 m solution of NaCl or a 1.5 m solution of $MgCl_2$?

24. Which will boil at a higher temperature – a 1.5 m solution of $C_6H_{12}O_6$ or a 1.5 m solution of NaCl?

25. Calculate the molarity of a solution if 236g of HI is dissolved in 17,500mL of solution?

26. Determine the mass of solute in 2000mL of a 0.25M solution of $CuSO_4$.

27. Calculate the molarity of 114g $Al_2(SO_4)_3$ in 1500mL of solution.

28. Calculate the weight of KBr needed to make 200g of a 5% solution.

29. Calculate the mass of solute is needed to make 350mL of a 0.1M solution of C_2H_5OH.

30. Calculate the molality of a solution in which 115g $AlCl_3$ in 1500g water.

31. What would be the freezing point and boiling point of the solution in #18

Acids and Bases

32. Calculate the pH and pOH of the following solutions:

0.00001M HNO_3	0.00254M HCl
0.001M KOH	0.0035M H_2SO_4
.00002M HCl	0.00044M H_2SO_4

33. Calculate the pOH, hydronium ion, and hydroxide ion concentration for a solution with a pH of 5 and a solution with a pH of 12.35.

34. Identify the conjugate base for the following:
    a. HCl
    b. H_2SO_4
    c. H_2O
    d. HSO_4^{-1}

35. Identify the conjugate acid for the following
    a. NO_3^-
    b. NH_3
    c. $H_2PO_4^{-1}$
    d. H_2O

36. Label the acid, base, conjugate acid and conjugate base for the following:
    a. $HCN(aq) + H_2O \rightleftharpoons H_3O^+(aq) + CN^-(aq)$
    b. $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$

37. During a titration process, 35mL of 2.0M H_2SO_4 neutralizes exactly 20.0mL of NaOH.
    a. Predict the products
    b. Balance the equation
    c. Label the acid, base and salt
    d. Name the salt
    e. Calculate molarity of the base solution.

38. Complete the following for the neutralization reaction between NaOH and HCl.
    a. Predict the products
    b. Balance the equation
    c. Label the acid, base and salt
    d. If 15.2 mL of a 1.7 M NaOH solution are needed to neutralize 22 mL of HCl, what is the molarity of the HCl?

39. For the following equations:

- Assign oxidation numbers to all atoms
- Identify which element is oxidized and which is reduced

a. $CrCl_3 + MnO_2 + H_2O \longrightarrow MnCl_2 + H_2CrO_4$

b. $Fe_2O_3 + Al \longrightarrow Al_2O_3 + Fe$

c. $PbO_2 + HCl \longrightarrow PbCl_2 + H_2O + Cl_2$

d. $HNO_3 + Cu \longrightarrow H_2O + Cu(NO_3)_2 + NO_2$

e.

40. Use the solubility curve chart to answer the following:

a. How many grams of $Ce_2(SO_4)_3$ will dissolve in 100 g H_2O at 10°C?

b. How many grams of $NaNO_3$ will dissolve in 100 g H_2O at 60°C?

c. How many grams of NH_3 will dissolve in 100 g H_2O at 90°C

d. Identify the following solutions as saturated, unsaturated or supersaturated:
   i. A solution of $KClO_3$ at 40 °C contains 45 g in 100 g H_2O.

   ii. A solution of NH_4Cl at 40 °C contains 45 g in 100 g H_2O

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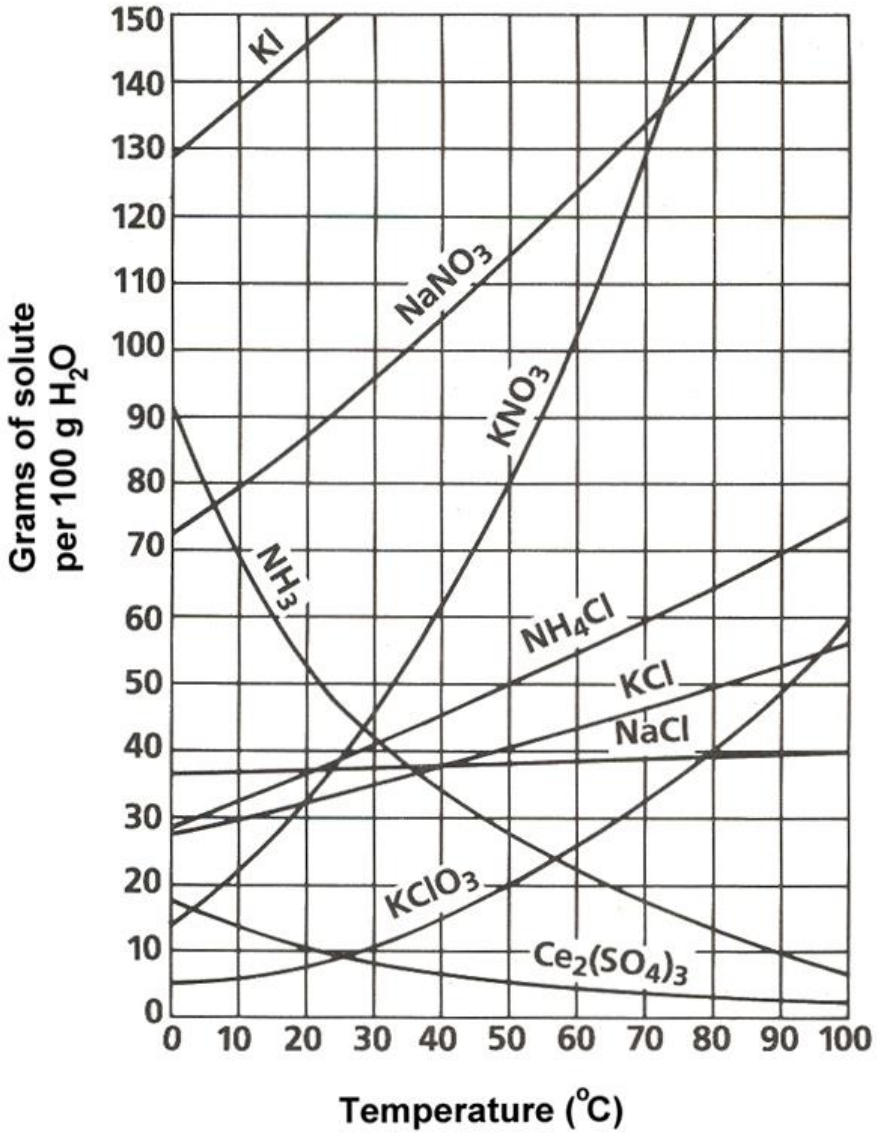
   iii. A solution of KNO_3 at 40 °C contains 45 g in 100 g H_2O.

e. How many grams of KNO_3 can be added to 100 g of H_2O if the temperature is increased from 0 °C to 60 °C ?

f. How many grams of KCl will precipitate out of 100 g of water that is cooled from 80 °C to 20 °C ?


Grams of solute per 100 g H_2O
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0 10 20 30 40 50 60 70 80 90 100
Temperature (°C)
KI
$NaNO_3$
KNO_3
NH_3
NH_4Cl
KCl
NaCl
$KClO_3$
$Ce_2(SO_4)_3$